CHANGES OF VITAMIN A METABOLISM AFTER TOTAL PANCREATECTOMY.

Kishimura, Harumi

CHANGES OF VITAMIN A METABOLISM AFTER TOTAL PANCREATECTOMY.

by

HARUMI KISHIMURA

From the First Surgical Division, Kyoto University Medical School
[Director : Prof. Dr. CHISATO ARAKI]

(Received for Publication : March 6, 1955)

Reports[1~5] have been accumulated on the lowered digestion and absorption of the nutrients, particularly on the impaired absorption of fat, in the individuals after total pancreatectomy, owing to the elimination of the external secretion. HAMANO[6] in our laboratory had also confirmed this fact. It is readily assumed that the absorption of vitamin A, one of the fat-soluble vitamins would also be diminished concurrently. CHESNEY and McCOOD,[7] MAY and McCEWARY,[8] ADLENSBERG and SOBOTKA,[9] and many others reported that there was the impaired absorption of vitamin A from the intestine in cystic fibrosis of the pancreas, sprue, celiac disease, etc. —— a type of disease accompanying steatorrhea.

I encountered a patient in whom visual disturbance had developed eight months after total pancreaticoduodenectomy which was improved by the administration of vitamin A. Since the recent success in dispersing vitamin A in water with the aid of the emulsifying agent, aqueous preparation of vitamin A has been used by LEWIS et al.,[10] KRAMER and SOBEL,[11] POPPER and VOLK,[12] FOX,[13] JONES et al.,[14] and others in the treatment of the aforementioned diseases associated with steatorrhea, and has proved itself very effective. BARNES et al.,[15] UYEYAMA and GIANCIRACRA[16], however, are rather sceptical about the effectiveness of aqueous vitamin A preparation.

This study aims to elucidate the actual manner of vitamin A absorption in pancreatectomized individuals, and thus to make an approach to the metabolism of vitamin A.

METHODS OF EXPERIMENT

In this experiment adult dogs of both sexes weighing about 10 kg were used. Early in the morning fasting dogs received orally 7,000 I. U. of oily Chocola A[a] per 1 kg of body weight in capsule according to the method of JONES[14] and BARNES.[15] Prior to the administration, and 3, 5, and 7 hours after the administration blood specimens were taken. The serum was saponified for the use in vitamin A analysis by the original method of YUDKIN,[17] and the levels of serum vitamin A and carotene were determined by a slightly modified FUJITA-AOYAMA's G. D. H. (activated glycerol dichlorohydrin) method,[18] employing a photoelectric colorimeter.

In case of the intravenous administration of vitamin A, fasting animals, anesthetized with 30 mg of Isomytal given intraperitoneally per 1 kg of body wight, received 500 I. U. of aqueous Chocola A[c] per 1 kg of body weight by way of a vein of the hind-limb within 5 seconds. Blood samples and liver specimens were taken immediately before and 15, 45, 60, 90, and 120 minutes after the administration, and the levels of serum vitamin A and carotene were determined by the methods stated above. Vitamin A and carotene concentration in the liver tissue were determined by the modified method of SOBEL.[19]

In dogs the duodenum and the pancreas are situated very closely together and have an almost inseparable relationship in the distribution of their blood vessels. For this reason the total pancreatectomy often causes necrosis of the duodenum and eventually the death of the animal. In order to avoid such complications, the necessity of total pancreaticoduodenectomy followed by gastrojejunostomy, and choledochojejunostomy has been pointed out by HONJO.[20] This mode of operation, however, particulary in experimental dogs, occasionally gave rise to transient stricture of the common bile duct (jaundice) and infection of the choledochus and the liver. On the other hand, JONES,[14] POPPER,[21] ADLERSBERG,[22] RUFFIN[23] and WHITE[24] reported that (i) institution of the anastomosis between intestine, (ii) stenosis of the bile duct and (iii) hepatitis led to an impairment of vitamin A metabolism, particularly of its absorption from the intestine and consequently of its utilization, resulting in the changes of vitamin A levels in the blood.

In an attempt to study the physiological change which is purely ascribed to the lack of the pancreas without incurring necrosis of the duodenal wall, I devised an operative procedure and practised it in cooperation with HASEGAWA. The pancreatic branches of the pancreaticoduodenal vessels were carefully separated and severed, leaving the duodenal branches of these vessels intact, and thus we succeeded in the protecion of the duodenum from becoming necrotic after resecting the pancreas totally. I ascertained, at autopsy, the successful results of our operation. In this way, I could easily prevent the animals from developing obstructive jaundice and infection of bile ducts.

In the case of subtotal resection of the pancreas, I usually left about 1/10 of the pancreatic tissue adjacent to the opening of the main pancreatic duct.

Both totally and subtotally depancreatized dogs were treated with regular insulin (5 to 6 I. U. a day) to keep them in hyperglycemia from 200 to 500 mg/dl..

Concerning the technique of ligation of the pancreatic duct, double ligations were performed at the site where the pancreas was attached to the duodenum. After severing the pancreas from the duodenum the great omentum was inserted between both tissues in order to avert the development of the postoperative internal pancreatic fistule. In this operation impending necrosis of the duodenal wall was recognized occasionally during the operation, necessitating the resection of necrotic duodenum. In this study, however, only the dogs that had not undergone resection

a) "Chocola A" manufactured by Sansho Seiyaku Co., Ltd., Tokyo. Oily Chocola A contains 50,000 I.U. of vitamin A palmitate in 1 g.
b) Water soluble Chocola A contains 30,000 I.U. of vitamin A palminate in 1 g.
c) Water soluble Chocola A for injection contains 25,000 I.U. of vitamin A palmitate in 1 cc.

of the duodenum were used.

REULTS

A) Serum Vitamin A and Carotene Levels :

The serum vitamin A and carotene levels in the normal fasting adult dogs (female 17, male 17) are presented in Table 1. This table indicates that the difference in sex has no direct influence on the serum vitamin A and carotene levels. This seems to be applied also to the totally depancreatized dogs as shown in Table 2, in which the serum vitamin A and carotene levels in the totally depancreatized animals (female 10, male 7) are summarized. Table 2 clearly shows that the serum vitamin A levles of totally depancreatized dogs are much less than those of normal animals. No significant difference in the carotene levels, however, seems to exist between the normal and depancreatized animals. Similar results were obtained in men, though small in number, as shown in Table 3.

B) Oral Administration of Oily Vitamin A Preparation :

Results obtained from normal dogs (female 5, male 4) are listed in Table 4. Showing a gradual increase, serum vitamin A levels reached their peak, except in two cases, 5 hours after the oral administration of oily vitamin A preparation. The minimum rise in serum vitamin A ranged between 33.4 and 178.5 I.U./dl. and the maximum rise between 118.6 and 304.2 I.U./dl.. Fig. 1 is the average rise curve drawn from the above results, and shows that in normal dogs the serum vitamin A levels are higher in female than in male. In contrast to the fairly settled tendency in the change of values of serum vitamin A, no definite tendency was observed in those of serum carotene.

No significant difference in the serum vitamin A levels was found between the normal dogs and the dogs Nos. 17 and 32 which had been injected with 5 I.U. of insulin before the test.

Changes in serum vitamin A and carotene levels in normal human subjects following the oral administration of oily vitamin A preparation were nearly similar to those observed in dogs (Table 5), but no significant difference was recognized between the two sexes.

The vitamin A tolerance curve was abnormally flat in the totally depancreatized dogs (female 2, male 3), though like in cases of normal dogs the peak of levels was reached 5 hours after the oral administration of oily vitamin A. The minimum rise of serum vitamin A ranged between 2.1 and 14.1 I.U./dl. and the maximum rise between 13.2 to 72.2 I.U./dl.. The maximum rise of serum vitamin A in the totally depancreatized dogs was no more than the minimum rise in the normal dogs (Table 6 and Fig. 1). In totally depancreatized dogs, no significant difference in the serum vitamin A levels was recognized according to the difference in sex. Totally depancreatized dogs Nos. 51 and 64, which had been injected with 5 I.U. of insulin before the test showed no marked difference from the dogs without insulin injection in their changes of serum vitamin A levels.

Only one human subject was available for the study of vitamin A. He had undergone the operation of total pancreaticoduodenectomy with gastrojejunostomy and choledocojejunostomy for pancreatic carcinoma about two years before the test. At the time of the test, his hepatic function was normal except that urobilinogen was positive in his urine. The serum vitamin A levels of this subject following the oral administration of oily vitamin A preparation showed an abnormally flat curve as in the cases of depancreatized dogs (Table 5 and Fig. 2). Concerning the changes of carotene levels no definite tendency was observed also in this patient. In dogs, the serum vitamin A levels after pancreatic duct ligation were higher than those after total pancreatectomy, although markedly lower than those of normal ones, as shown in Table 6. In one patient, showing normal blood sugar level and no disturbance of hepatic function nine months after partial pancreatoduodenectomy unaccompanied by pancreatojejunostomy for his pancreatic carcinoma, oily vitamin A preparation was orally administered, the results being the same as in Fig. 2.

Table 6 also indicates that the results obtained in partially depancreatized dogs resembled those obtained in normal animals. Even if the greater part of the pancreas was resected and postoperative hyperglycemia resulted, almost the same grade of increase in the serum vitamin A levels as those in normal dogs was observed after the oral administration of oily vitamin A preparation, only if the external secretory function of the pancreas was not impaired. If, however, the external secretion was disposed of, not only the totally depancreatized dogs but the animals preserving the internal secretory function showed markedly less increase in serum vitamin A levels in the tolerance test than is the case in normal dogs. Insulin injection in this case does not seem to have any significant effect on the serum vitamin A levels.

Attempting to exclude the possibility that in totally depancreatized dogs or in dogs with ligation of the pancreatic duct the orally given capsules containing the test dose might not be easily soluble in the intestinal canal and consequently the tolerance curve might appear in flatness, I administered oily vitamin A without using capsules to the dog No. 40. Results thus obtained, however, did not differ to any important degree from that obtained in other dogs with total pancreatectomy. This is shown too in Table 6. Even when 1 g of lipase was added to oily vitamin A preparation in totally depancreatized dogs, no particular rise could be seen in the levels of serum vitamin A.

Two weeks after the examinations stated above (control), the test was again repeated with the additional administration of Sorla-Bilein,[d] which is known to have a marked effect in improving the absorption of fat from the small bowel. As shown in Fig. 3, the use of Sorla-Bilein accelerated the rise of serum vitamin A levels in normal subjects (both men and dogs). The highest value in these cases

d) Sorla-Bilein manufactured by Abbott Laboratories Co., Ltd., Chicago and contains Polysorbate 80, Abott 0.4 g, Abbott's Dried and Purified Oxibile 30 mg, and Dehydrocholic Acid 30 mg in 1 g.

was attained as early as within 3 hours after administration showing a good contrast to the cases not administered with Sorla-Bilein. In the subjects operated on(totally depancreatized men and dogs, and a man whose pancreatic head and duodenum was resected without additional pancreatojejunostomy), however, the effect of Sorla-Bilein was so slight that it could hardly be noticed.

C) Oral Administration of Aqueous Vitamin A Preparation :

Results of the test in normal dogs (female 5, male 4) are given in Table 7. In these cases, just as in cases of oily vitamin A preparation, changes of the serum carotene levels showed no definite trend. In general, however, the changes were less pronounced. The minimum rise of serum vitamin A levels in the normal animals ranged from 36.3 to 182.7 I.U./dl. and the maximum from 90.1 to 287.7 I.U./dl.. The peak in the tolerance curve was recorded 5 hours after the administration as in the case of oily preparation (Fig. 4). Serum vitamin A level in female was significantly higher than that in male. The increase in the serum vitamin A level after the administration of aqueous vitamin A preparation did not seem to differ much from that following the oily vitamin A administration. In both cases, insulin did not appear to have any important effect on the increase in the plasma vitamin A level (dogs Nos. 13 and 26 in Table 7).

In totally depancreatized dogs (female 2, male 2), minimum rise in serum vitamin A ranges from 0 to 26.0 I.U./dl., and the maximum from 43.8 to 65.6 I.U./dl.. Rises of the serum vitamin A following the administration of aqueous praparation were somewhat more marked, as shown graphically in Fig. 5, than those in cases of oily vitamin A administration, but were apparently less than those in normal subjects (Table 8 and Fig. 4). By the reason given in the preceding section, dogs Nos. 40 and 50 were administered with aqueous vitamin A preparation without using capsules, and the rasults thus obtained showed no particular difference from those obtained in dogs in which capsules were used (Table 8).

In dogs with ligation of pancreatic ducts, results of the test were nearly the same as those obtained in depancreatized ones. Lowered activity in the external pancreatic secretion seems to cause the decrease in the serum vitamin A levels. Insulin did not appear to have any significant effect on the value of serum vitamin (Table 8).

D) Intravenous Administration of Aqueous Vitamin A Preparation :

Results of the test with the normal dogs are summarized in Table 9. No definite trend was observed in the changes of the serum carotene levels.

Serum vitamin A levels reached their highest value 15 minutes after the intravenous administration of aqueous vitamin A preparation and then dropped gradually. Vitamin A concentration of the liver tissue showed the marked increase 15 minutes after the injection. Forty-five minutes after the injection of vitamin A, its concentration in dogs Nos. 60, 61, and 66 showed the decrease even below the level recorded prior to the injection, and then it began to increase again with the lapse of time. The increase in vitamin A concentration in the liver tissue seemed to be inversely proportional to the decrease in serum vitamin A level (Tables 9 and 10, and Fig. 6).

In totally depancreatized dogs (female 4, male 2), dogs Nos. 53, 56, 57, and 58 showed almost the same changes of serum vitamin A levels as those of the normal ones (Table 9). Vitamin A concentration in the liver of the dog No. 53 rose to its highest value 15 minutes after the injection, and dropped below the preinjection level within 45 minutes, and increased again to the preinjection level within 90 minutes reaching finally the higher level 120 minutes after the injection. Considering these results, one could not find any appreciable difference in the change of values of vitamin A in the liver tissue between normal and depancreatized dogs. Dogs Nos. 56 and 58 and the dog No. 57 behaved somewhat differently in their test. In the former two, vitamin A concentration in the liver reached the lowest value fifteen minutes after the injection, and in the latter it started to increase 15 minutes after the injection without showing any decrease thereafter. In dogs Nos. 10 and 50 serum vitamin A levels persistently elevated after the injection, while concentrations of vitamin A in the liver were lowered continuously after the injection to a certain period when they began to increase 60 and 90 minutes respectively after the injection (Tables 9 and 10). To summarize, an equal amount of vitamin in aqueous medium administered intravenously produced almost the same change of serum vitamin A level both in pancreatectomized dogs and in normal ones. There were, however, divergent changes from case to case with regard to the concentration of vitamin A in the liver, although it tended generally to increase gradually (almost in inverse proportion to the level of serum vitamin A) after the end of 60 minutes following the injection (Fig. 6). Such an increase in depancreatized dogs seems to occur in nearly the same degree as that in normal dogs, as is suggested by the fact that vitamin A concentrations of the liver tissue measured at the end of the assay in depancreatized dogs coincide roughly with those in normal ones (when indicated by the increment of ratio— the ratio of the amount of vitamin A of the liver to that of injected vitamin A) (Table 10 and Fig. 6).

DISCUSSION

The relationship of diabetes mellitus to vitamin A metabolism has already been discussed in the literature. Some authors[25~32] indicated that the conversible process of carotene to vitamin A was retarded in diabetes mellitus because of the lowered value of serum vitamin A and hypercarotenemia. But, according to KIMBLE,[33] these evidences were not regarded as reliable enough to make a conclusion on this problem.

After total pancreatectomy, in dogs and men, I noted marked decrease in the value of serum vitamin A, whereas the value of serum carotene was not significantly different from that of normal individuals.

If the external secretion was expelled, not only the totally depancreatized dogs but also the animals whose pancreatic duct was ligated leaving the endocrine activity intact, abnormally flat tolerance-curves were seen after oral administration of oily vitamin A preparation. The effect of insulin on the curves was hardly recognized in totally depancreatized dogs. The lowering of the level of serum vitamin A is considered to be due to 3 factors —— (a) impaired absorption of vitamin A, (b) unusually high destruction of vitamin A once absorbed, (c) increased capacity of the organs, particulaly of the liver to store vitamin A. Considering the data acquired after intravenous administration of vitamin A as shown in Fig. 6, one could easily exclude the possibility of the last two factors (b and c). The lowered level of serum vitamin A is considered therefore to be due to the impaired absorption from the intestine. In totally depancreatized subjects the flatness of the tolerance-curve could not be improved by adding lipase. In my study, despite the reports of other authors[10~14] that the absorption of vitamin A was markedly augmented in patients with steatorrhea when vitamin A was given in form of aqueous preparation or when it was given in form of oily one with emulsifying agent, administration of aqueous preparation with or without addition of Sorla-Bilein could hardly raise the level of serum vitamin A—— the level thus secured being still distinctly below the average one in normal individuals, a fact indicating that the absorption from the intestine was still depressed considerably. SHOSHKES[34] reported, using a closed jejunal and caecal loop, that the absorption of corn oil was found to be promoted more or less after administration of Tween 80 or 6 % Soybean Phosphate, never attaining to the normal level. The result of my study on dogs whose pancreas was removed totally or whose pancreatic duct was ligated, coincided with that of SHOSHKES, indicating that vitamin A in aqueous medium could not be substituted fully for natural pancreatic juice. Just as in case of oily vitamin A administration of insulin before the test did not significantly effect the absorption of the aqueous preparation of vitamin A in totally depancreatized dogs. In normal dogs, after the oral administration of either oily or aqueous vitamin A, the serum vitamin A concentration became higher in female than in male. It had been reported by the former investigator[35~41] that in the liver, more vitamin A was retained in female rats than in males and more vitamin A in castrated male rats and mice than in uncastrated ones. No report has ever been presented on the difference due to sex in the response of serum vitamin A levels to the oral administration of oily and aqueous vitamin A preparations. After intravenous administration of vitamin A, no conspicuous diffrence due to sex was noted in the concentration of vitamin A of the liver tissues. From these facts I can assume that there is more active absorption of vitamin A from the intestine in female animals than in male ones. Since these studies were done in the season of sexual excitement in experimented animals, the influence of sexual hormone might be considered paticularly. It is generally accepted that the greater capacity of the liver of female animals for storage of vitamin A is a condition provided for pregnancy and lactation. That no difference could be found with regard to sex in pancreatectomized dogs may be due to the altered hormonal balance associated with disturbed homeostasis of the organism, owing to deprivation of the endocrine secretion of the pancreas.

In view of the markedly lowered absorption of vitamin A from the intestine after total pancreatectomy or pancreatic duct ligation, parenteral administration of the vitamin appears to be recommedable. It was reported[42~43] that any significant elevation of vitamin A concentration in the liver and plasma were hardly recognizable after intramuscular injection of the oily vitamin A. It was further reported[11] that a little better result was noted after the intramuscular injection of aqueous vitamin A.

Following the intravenous injection of vitamin A there was almost an equal rise of serum vitamin A levels, both in depancreatized dogs and in normal ones; moreover, vitamin A concentration in the liver rose almost equally at the end of 60 minutes after the injection. It is, therefore, reasonable to assume that the ability of the animals to store vitamin A is preserved after total pancreatectomy or ligation of pancreatic ducts. During the first 60 minutes after the intravenous administration of vitamin A, there was a noticeable fluctuation in the amount of vitamin A contained in the liver in normal dogs as shown in Fig. 6 : after a relatively larger amount of vitamin A was introduced intravenously, a transient uptake of vitamin A by parenchymatous liver cells, particularly by KUPFFER cells took place, and in turn, this caused an abrupt rise of vitamin A content in the liver at the end of 15 minutes after its injection. Such condition seemed to stimulate the autonomic nervous system, causing a pronounced decrease in vitamin A content of the liver at the end of 45 minutes, sometimes to the level below that before the injection. In favor of such interpretation as this, an evidence has been presented by THIELE[41] that vitamin A contained in the liver shifted to the circulating blood about the end of 30 minutes after the injection of adrenalin. The altered behavior of the liver in pancreatectomized dogs during the first 60 minutes after receiving vitamin A, appears to be due to the functional deviation of the autonomous nervous system after the operation. Further discussion on this subject is impossible because we have no relevant report to the present problem.

SUMMARY

(1) Totally depancreatized individuals, dogs or patients, showed markedly lower levels of serum vitamin A than normal ones, while serum carotene levels in these subjects did not significantly differ from those in the normal ones.

(2) After oral administration of oily vitamin A, absorption of it was found distinctctly subnormal in the depancreatized dogs, in the dogs whose pancreatic duct was ligated, and in the patients who underwent pancreatectomy. With regard to carotene levels a definite tendency could not be detected. After subtotal pancreatectomy a bsorption of vitamin A from the intestine was maintained in the normal range, even in the presence of diabetes mellitus, only if exocrine function of the pancreas is not abolished completely.

(3) Impairment of absorption of vitamin A could not be lessened by the oral use of lipase or Sorla-Bilein.

(4) With aqueous preparation of vitamin A, if administered orally, the rate of absorption of vitamin A improves a little better than with oily preparation, although still far below the normal range. As in case of oily preparation, there was no consistent response in carotene levels after the administration of aqueous preparation.

(5) Absorption of vitamin A, administered either in oily medium or in aqueous one, from the intestine in normal dogs or depancreatized ones was not significantly influenced on by the previous medication with insulin.

(6) Regardless of oily or aqueous vitamin A, if administered orally to normal animals, the absorption of them is better in females than in males. No such difference between both sexes occurred in the group of depancreatized dogs.

(7) After intravenous administration of aqueous vitamin A the level of vitamin A both in normal dogs and in depancreatized ones rose almost equally. The amount of vitamin A in the liver rose 15 minutes after administration, and fell abruptly 45 minutes after administration, sometimes down below that prior to the administration. Beyond 60 minutes after administration it showed a steady increase inversely proportional to that of vitamin A.

(8) The amount of vitamin A contained in the liver showed fluctuations in totally depancreatized dogs within the first 60 minutes after vitamin A injection, and then started to increase constantly just as in normal dogs, in inverse proportion to the value of serum vitamin A.

(9) In the case of total pancreatectomy or ligation of pancreatic duct it seemed advantageous to administer vitamin A parenterally, paticularly intravenously.

I wish to thank Prof. Dr. CHISATO ARAKI and Assist. Prof. Dr. ICHIO HONJO for their guidance throughout the period of this work. I am also grateful to the First Division of Internal Medicine (Research Institute of Nutrition) of Kyoto University for many helps in carrying out this study.

REFERENCES

1) Selle, W. A. : The Effect of Entericcoated Pancreatin on Fat and Protein Digestion on Depancreatized Dogs. J. Nutr. **13** ; 15, 1937. 2) Caffey, R. J. : The Influence of the Pancreas on the Utilization of Foodstuffes. Am. J. Digest. Dis. **7** ; 141, 1940. 3) Dixon, C. F. : Total Pancreatectomy for Carcinoma of Pancreas in Diabetic Person. Metabolic Studies. Arch. Surg. **52** ; 619, 1946. 4) Fallis, L. S. : Observation on Some Metabolic Changes after Total Pancreatoduodenectomy. Am. Surg. **128** ; 639, 1948. 5) Friestley, J. T. : Total Pancreatectomy for Hyperinsulin due to Islet Cell-Adenoma Including Metabolic Studies. Am. Surg. **130** ; 211, 1949. 6) Hamano, K. : Digestive and Absorptive Functions of the Gastrointestinal Tract after Various Operations of the Pancreas, Especially Total Pancreatoduodenectomy. Sond. Arch. Jap. Chirur. **22** ; 500, 1953. 7) Chesney, J., and MeCood, A. B. : Vitamin A of Serum Following Administration of Haliver Oil in Normal Children and Chronic Steatorrhea. Proc. Soc. Exp. Biol. & Med. 31. 887. 1934. 8) May, C. D., and Mc Cewary, J, F. : The Absorption of Vitamin A in Celiac Disease. J. Ped. **18**, 200, 1941. 9) Adlensberg, S., and Sobotka, H. : Fat and Vitamin A Absorption in Sprue and Jejunoileitis. Gastroent. **1**, 357, 1943. 10) Lewis, J. M., Bodansky, O., Birminghan, J., and Cohlen, S. Q. : Compa-

rative Absorption, Excretion and Storage of Oily and Aqueous Preparations of Vitamin A. J. Ped. **31**, 496, 1947. 11) Kramer, B., Sobel, A. E., and Gottfied, S. P : Serum Levels of Vitamin A in Children a Comparison Following the Oral and Intramuscular Administration of Vitamin A in Oily and Aqueous Mediums. Am. J. Dis. Child. **73** ; 543, 1947. 12) Popper, H., and Volk, B. W.: Intestinal Absorption of Vitamin A from Aqueous and Oily Menstrum. Proc. Soc. Exp. Biol. & Med. **68** ; 562, 1948. 13) Fox, H. J. : Absorption of Unemulsified and Emulsified Vitamin A in Sprue. J. Lab. Clin. Med. **34**, 1140, 1949. 14) Jones, C. M., Culver, P. J., and Drumey, G. D. : Modification of Fat Absorption in the Digestive Tract by the Use of Oily and Emulsifying Agent. Annal. Int. Med. **29** ; 1, 1948. 15) Barnes, B, C., Wollaeger, E., and Mason, H. L. : The Comparative Absorption of Vitamin A Water-miscible and Oily Preparation by Normal Human Adults and Patients with Steatorrhea. J. Clin. Invest. **129** ; 982, 1950. 16) Uyeyama, K., Giansiracsa, J. E., Althausen, T. L., and Harper, H. A. : Alterations of Intestinal Absorption in Ulcerative Colitis by Tween 80, ACTH, and Cortisone. Gastroent. **23** ; 143, 1953. 17) Yudkin, S. : Estimation of Vitamin A and Carotene in Human Blood. Biochem. J. **35** ; 551, 1941. 18) Fujita, A., Aoyama, M. : Colorimetric Determination of Vitamin A with Glycerol Dichlorohydrin. Vitamin (Japan) **4**; 127. 1951. 19) Sobel, A. E., Sherman, M., Lichtbla , J., Snow, S., and Krāmer, B. : Comparison of Vitamin A Liver Storage Following Administration of Vitamin A in Oily and Aqueous Media. J. Nutrit. **35** ; 225, 1948. 20) Honjo, I. : Total Pancreatectomy. J. I. C. S. **19** ; 692, 1953. 21) Popper, H.: On the Variation of Plasma Vitamin A Level of the Administration of Large Dose of Vitamin A in the Liver Disease. J. Clin. Invest. **22** ; 775, 1943. 22) Adlersberg, D. : The Effect of Liver Disease on Vitamin A Metabolism. Gastroent. 4, 164, 1945. 23) Ruffin, J. M.: The Value of Plasma Vitamin A Determination in the Differential Diagnosis of Jaundice. Gastroent. 4, 466, 1945. 24) White, D., Bone, F. C., Ruffin, L. M., and Taylor, H. : Further Observation on the Value of Plasma Vitamin A Determination in the Differential Diagnosis of Jaundice. Gastroent. **14** ; 541, 1950. 25) Head, G. D.: Arch. Int. Med. **32** ; 200, 1921. 26) Stoner, W. C. : Am. J. Med. Sci, **175** ; 31, 1928. 27) Brandaleone, H.: Proc. Soc. Exp. Biol. & Med. **32** ; 200, 1934. 28) Ralli, E. P. : J. Lab' Clin. Med. **20** ; 1266, 1935. 29) Stueck, G. H. : Am. Med. Assoc. **109** ; 343, 1937. 30) Brayer, B. A. : S. African J. Med. **65** ; 90, 1940. 31) Donner, B. A. : S. African J. Med. Sci. **7** ; 109, 1942. 32) Ralli, E. P. : N. Y. Med. **5** ; 16, 1949 24—32) From Sobel, A. E. et al. Arch. Bioc. Biophys. **44** ; 1, 1953. 33) Kimble, M. A., Germek, O. C., and Germek, E. L. : Vitamin A and Carotene Metabolism in the Diabetic as Reflected by Blood Levels. Am. J. Med. Sci. **212** ; 574, 1946. 34) Shoshkes, M. : Fatemulsion for Oral Nutrition. 2. Failure of Phosphatide, Tween 80, or Choline to Influence Fat Absorption. Proc. Soc. Exp. Biol. of Med. 75 ; 680, 1950. 35) Brenner, S., Broodes, M. C. H., and Roberts, L. J.: The Relation of Liver Stores to the Occurrence of Early Sign of Vitamin A Deficiency in the White Rats. J. Nutrit **23** ; 459, 1942. 36) Callison, E. C., and Knowles, V. H. : Liver Reserves of Vitamin A and Their Relation to the Signs of Vitamin A Deficiency in the Albinorats. Am. J. Physiol. **143** ; 444, 1945. 37) Kimble, M. S. : The Photocolorimetric Determination of Vitamin A and Carotene in the Human Plasma. J. Lab. Clin. Med. **24** ; 1055, 1939. 38) Bult, A. R., and Sorgdrager, C. J. : The Influence of Sex and Castration in Male Rats upon of the Vitamin A Metabolism. Med. Tsch. Genelsk. **84** ; 1936, 1940. 39) Booth, V. H.: Liver Storage Vitamin A by Male and Female Rats. J. Nutrit. **48** ; 13, 1952. 40) Rush, B., and Truscott, B. L.: The Influence of Age, Strain, Castration and Estrogen upon Hepatic Stores of Vitamin A in the Mous. Endocrin. **49**; 461, 1951. 41) Truscott, B. L. : Foodintake and Hepatic Vitamin A in Castrated Mice. Science **17** ; 63, 1953. 42) Cienfuegos, S. : Comparison of Absorption of Vitamin A after Oral and Muscular Administration in Normal Children. J. Ped. **28** ; 191, 1946. 43) White, D. P., Bone, F. C., Ruffin, L. M., and Taylor, H. : Further Observation on the Value of Plasma Vitamin A Determination in the Differential Diagnosis of Jaundice. Gastroent. **14**; 541, 1950. 44) Thiele, W.Sym : pathicus Nervensystemund Vitam in A Haushalt. Klin. Wsch. 345, 1940(I).

和文抄録

膵全剔に於けるビタミンA代謝

京都大学医学部外科学第1講座（主任 荒木千里教授）
岸 村 治 美

正常，膵部分切除，膵管結紮犬並に臨床例を対照とし，膵全剔後の人並に犬に油性及び水溶性ビタミンAを経口的に又水溶性ビタミンAを経静脈的に負荷試験を行い，血清肝臓のビタミンA並にカロチン量をG.D.H.法により測定して次の結果を得た．

1) 膵全剔犬，膵全剔臨床例は共に正常例に比して血清ビタミンA量は著明に低値を示しているが，カロチン量は正常例と有意の差は認めない．

2) 油性ビタミンA経口負荷試験により膵全剔犬，膵管結紮犬，膵十二指腸全剔臨床例は共に正常例に比しビタミンAの吸収が著しく減少している．カロチン量は一定の傾向は認め難い．膵大部分切除の場合膵外分泌機能が多少とも維持されていると，たとえ高血糖が起つてもビタミンAの腸管よりの吸収は正常例と変らない．

3) 前記吸収の減少は Lipase, Sorla-Bilein の添加により改善されない．

4) 水溶性ビタミンAを用いての経口負荷試験では，油性に比し多少吸収の増加を認めるが，正常に比較して尚著明に減少している．カロチン量は油性と同様一定の傾向を示さない．

5) インスリンを負荷前に注射しても，正常犬，全剔犬共に油性，水溶性ビタミンAの腸管よりの吸収に認める可き影響を与えない．

6) 油性並に水溶性ビタミンA経口負荷正常犬の雌は雄に比しビタミンAの腸管よりの吸収が大であるが，膵全剔犬では雌雄に有意の差は認め難い．

7) 水溶性ビタミンA経静脈負荷に於ける血清ビタミンAの増加量及び増加比は正常犬，全剔犬共に略々同様の傾向を認めた．肝内ビタミンA量は正常犬では負荷後15分で上昇し，45分で急激に下降し時には負荷前値以下迄下るが60分以後は次第に上昇する傾向を示し，その増加は血清ビタミンAと反比例的な関係を示す．

8) 膵全剔犬の肝内ビタミンA量は60分迄は種々の反応態度を示すがそれ以後は増加量，増加比共に正常犬と略々同様の傾向を示し，血清ビタミンAと肝内ビタミンAとの増加の関係も正常犬と同様反比例的な関係を示す．

9) 膵全剔並に膵管結紮犬には非経口的にビタミンAを投与するが良く，特に静脈内投与が最良と考える．

Table 1. Serum Vitamin A and Carotene Levels in Normal Dogs.

Sex	♂		♀		
No. of Dogs	Carotene (γ/dl.)	Vitamin A (I.U /dl.)	Carotene (γ/dl.)	Vitamin A (I.U./dl.)	No. of Dogs
1	25.8	79.8	45.2	72.2	18
2	17.2	117.3	87.7	93.7	19
3	17.2	57.1	45.2	89.8	20
4	34.4	94.4	20.4	53.4	21
5	38.8	61.0	43.0	72.9	22
6	23.2	92.8	12.9	81.9	23
7	20.7	79.6	17.2	71.8	24
8	20.6	70.8	38.8	76.5	25
9	25.8	76.1	17.2	82.3	26
10	20.6	115.0	25.8	62.3	27
11	47.3	47.1	43.0	74.6	28
12	34.4	99.1	34.4	92.9	29
13	25.8	66.6	51.6	94.8	30
14	34.4	166.5	15.8	100.5	31
15	25.8	92.9	30.1	87.2	32
16	47.3	66.3	68.8	171.9	34
17	21.5	81.1	55.9	62.0	35
	Average 28.3±2.35	Average 86.1±6.77	Average 38.40±5.07	Average 84.8±6.49 f.E	

Table 2. Serum Vitamin A and Carotene Levels in Depancreatized Dogs.

No. of Dogs	Sex	Days after Operation	Carotene (γ/dl.)	Vitamin A (I.U./dl.)
12	♂	19	17.2	54.3
14		62	20.4	44.6
26		3	43.0	22.1
41		44	8.6	28.1
46		15	17.2	38.1
56		7	25.8	62.3
58		13	17.2	51.7
Average			54.3±2.55	129.8±10.23
5	♀	41	21.5	44.3
9		14	21.5	67.4
13		7	68.8	86.1
16		4	12.9	44.3
24		7	18.8	31.2
40		47	54.9	35.3
50		16	20.6	63.8
53		6	27.5	44.2
57		21	25.8	36.0
62		25	77.4	45.0
Average			35.0±7.7	49.8±5.53

Table 3. Serum Vitamin A and Carotene Levels in Normal and Depancreatized Men.

No. of men	Sex	Operation	Carotene (γ/dl.)	Vitamin A (I.U./dl.)
1	♂	Normal	55.9	107.5
2			38.2	126.8
3			51.2	135.0
4			72.0	150.0
Average			54.3±2.55	129.8±10.23
5	♀	Normal	39.6	77.4
6			55.9	130.2
7			51.6	118.5
8			68.5	138.0
Average			53.5±6.9	116.0±15.58
9	♀	Depancreatized (totally)	58.5	47.7
10	♂	Depancreatized (partially)	64.5	22.3

Fig. 1. Average Vitamin A Tolerance Curves in Normal and Depancreatized Dogs Following Oral Adminitration of Oily Vitamin A.

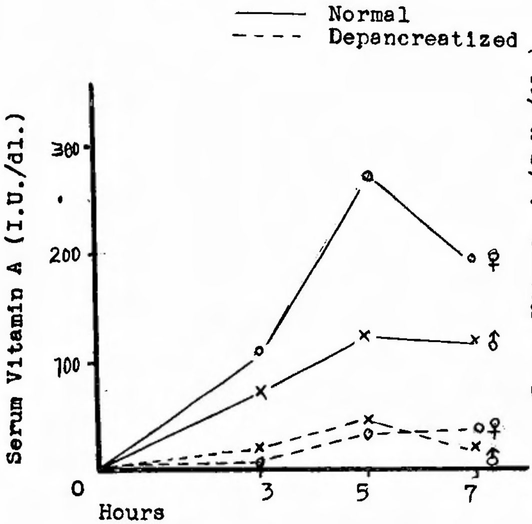


Fig. 2. Serum Vitamin A Tolerance Curves in Men with Oral Adminstration of Oily Vitamin A.

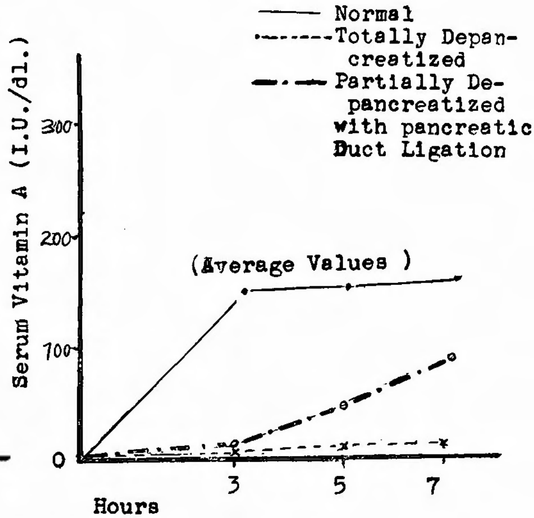


Table 4. Serum Vitamin A and Carotene Levels in Normal Dogs with Oral Administration of Oily Vitamin A. (7,000 I. U. Per kg of Body Weight).

No. of Dogs	Sex	Time	Before Administ.	After Administrat. (3 Hours)	After Administ. (5 Hours)	After Administration (7 Hours)
5	♂	Carotene (γ/dl.)	38.7	83.9	103.2	103.2
		Vitamin A (I.U./dl.)	61.6	156.8	161.7	309.6
		Increment (I.U./dl.)		95.2	100.1	248.0
16	♂	C.	47.3	21.5	21.5	21.5
		V. A	66.3	142.3	212.3	124.8
		I.		76.0	146.0	58.5
17	♂	C.	21.5	17.2	17.2	21.5
		V. A	81.1	165.5	209.2	151.1
		I.		84.4	128.1	70.0
18	♀	C.	45.2	90.3	25.8	103.2
		V. A	72.2	133.0	331.8	295.4
		I.		60.8	259.6	223.2
30	♀	C.	34.4	43.0	41.3	34.4
		V. A	92.9	317.9	397.1	214.4
		I.		225.0	304.2	121.5
31	♀	C.	51.6	21.5	37.8	43.0
		V. A	94.8	143.2	352.7	359.9
		I.		48.4	257.9	265.1
32	♀	C.	15.8	8.6	8.6	12.9
		V. A	100.5	133.9	378.9	298.9
		I.		33.4	278.4	198.4
36′	♂	C.	103.2	77.4	58.1	64.5
		V. A	46.0	139.3	164.6	145.1
		I.		93.3	118.6	99.1
38′	♀	C.	25.8	25.8	25.8	25.8
		V. A	59.5	238.0	322.0	238.0
		I.		178.5	262.5	178.5
11*	♂	C.	47.3	47.3	47.3	34.4
		V. A	47.1	73.3	160.8	147.2
		I.		26.2	113.7	100.1

* Without Capsule ′ Insulin 5 I. U. Injected (Before Test)

Table 5. Serum Vitamin A and Carotene Levels in Normal and Depancreatized Men with Oral Administration of Oily Vitamin A (7,000 I. U. per kg of Body Weight)

No. of men	Sex	Operat.	Time (Hours)	Before Administ.	After Administ. (3)	After Administ. (5)	After Administ. (7)
1	♂	Normal	Carotene (γ/dl.)	55.9	60.2	48.2	55.9
			Vitamin A (I.U./dl.)	107.5	297.7	328.7	422.5
			Increment		190.2	221.2	315.0
2	♂	Normal	Carotene	38.2	41.3	55.0	44.7
			Vitamin A	126.8	306.9	331.7	308.6
			Increment		180.1	204.9	181.8
5	♀	Normal	Carotene	39.6	51.6	60.2	43.0
			Vitamin A	77.4	275.0	219.9	207.6
			Increment		197.6	142.5	130.2
6	♀	Normal	Caratene	55.9	51.6	51.6	51.6
			Vitamin A	130.2	192.8	236.5	228.0
			Increment		62.6	106.3	97.8
9	♀	Total Pancrea-tectomy	Carotene	53.1	53.1	20.4	20.4
			Vitamin A	47.7	47.7	63.6	70.8
			Increment		0	15.9	23.1
10	♂	Partial Pancrea-tectomy withDuc-trigation	Caratene	64.5	64.5	20.4	58.1
			Vitamine A	22.3	26.2	78.7	130.2
			Increment		3.9	56.4	107.9

Fig. 3. Effect of Sorla-Bilein on Vitamin A Tolerance Curves in Normal Subjects and Depancreatized Ones Following Oral Administration of Oily Vitamin A (7,000 I. U. per kg of body weight).

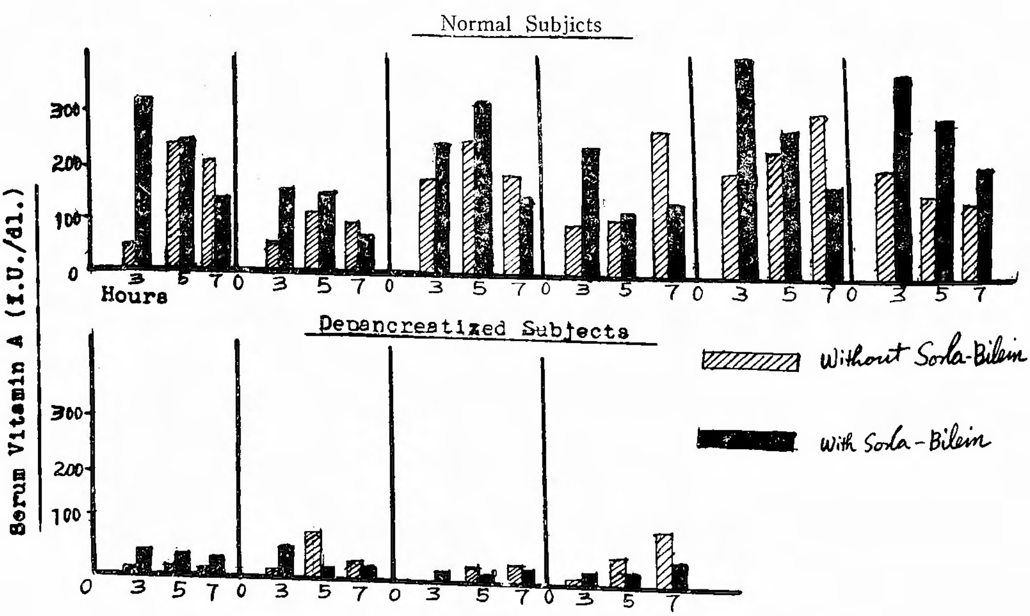


Fig. 4. Averaged Vitamin A Tolerance Curves in Normal and Depancreatized Dogs Following Oral Administration of Aqueous Vitamin A.

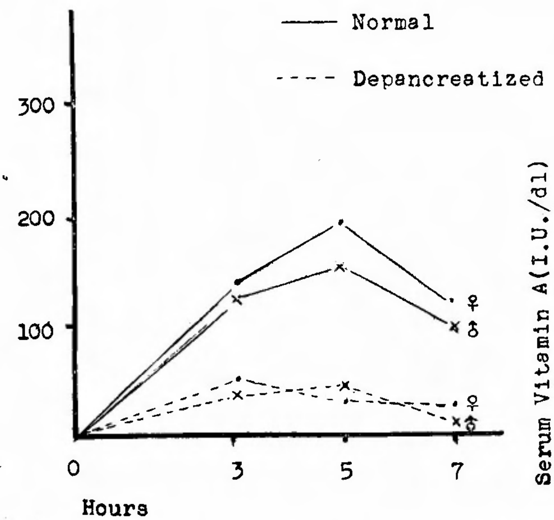


Fig. 5. Comparison of Vitamin A Tolerance Curves in Totally Depancreatized Dogs Following Oral Administration of (i) Oily Vitamin A and of (ii) Aqueous Ones.
......Aqueous ——Oily

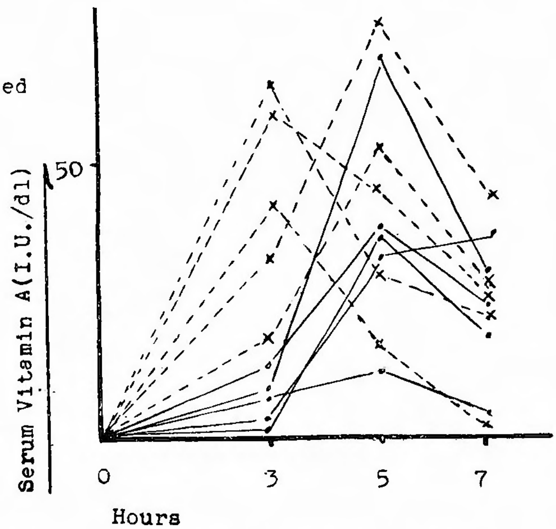


Table 6. Serum Vitamin A and Carotene Levels in Depancreatized Dogs with Oral Administration of Oily Vitamin A (7,000 I. U. per kg of Body Weight)

No. of Dogs	Sex	Operation	Days after Oper.	Time	Before Administ.	After Admin. (3 Hours)	After Admin. (5 Hours)	After Admin. (7 Hours)
9	♀	totally Depancreatized Dog	19	Carotene(γ/dl.)	21.5	15.5	25.8	10.3
				Vitamin A (I.U./dl.)	73.9	77.0	112.0	94.5
				Increment (I.U./dl.)		3.1	38.1	20.6
12	♂	〃	19	C.	17.2	43.0	34.4	17.2
				V. A	54.3	68.5	94.7	80.5
				I.		14.2	40.4	26.2
14	♂	〃	45	C.	12.9	12.9	12.9	12.9
				V. A	33.3	42.0	46.4	38.1
				I.		8.7	13.1	4.7
51′	♂	〃	14	C.	25.8	43.0	8.6	8.6
				V. A	50.0	60.0	125.0	81.5
				I.		10.0	75.0	31.5
64′	♀	〃	25	C.	77.4	45.2	51.6	64.5
				V. A	45.0	59.1	79.3	83.9
				I.		4.1	34.3	38.9
40*	♀	〃	43	C.	30.1	34.4	34.4	43.0
				V. A	43.5	59.7	77.2	65.7
				I.		16.2	33.7	22.2
46#	♂	〃	29	C.	25.3	34.4	34.4	25.8
				V. A	35.0	59.7	72.8	62.3
				I.		24.7	37.8	27.3
3	♀	Partially Depancreatized Dog	20	C.	12.9	28.4	25.8	38.7
				V. A	81.9	226.0	533.0	572.9
				I.		144.1	451.1	491.0
65	♂	〃	270	C.	32.3	90.3	77.4	72.2
				V. A	41.1	108.3	158.8	134.1
				I.		67.2	117.7	93.0
17	♂	Pancreatic Duct Ligation	19	C.	17.2	25.8	21.5	17.2
				V. A	45.6	97.3	96.8	80.6
				I.		51.7	51.2	35.0

′ Dogs Injected with Insulin Before Test * Without Capsule
Oral Administration of Oily Vitamin A and Lipase 1,0 g..

Table 7. Serum Vitamin A and Carotene Levels in Normal Dogs with Oral Administration of Aqueous Vitamin A (7,000 I. U. per kg of Body Weight).

No. of Dogs	Sex	Time (Hours)	Before Administ.	After Administration 3	5	7
3	♂	Carotene (γ/dl.)	17.2	43.0	51.6	51.6
		Vitamin A (I.U./dl.)	57.1	197.1	264.5	159.5
		Increment (I.U./dl.)		140.0	207.4	102.4
4	♂	C.	34.4	17.2	25.8	30.1
		V. A	94.7	165.4	184.8	131.0
		I.		70.7	90.1	36.3
10	♂	C.	20.6	17.2	25.8	12.9
		V. A	115.1	257.3	241.1	223.6
		I.		142.2	126.0	108.5
13′	♂	C.	25.8	25.8	31.0	25.8
		V. A	66.6	263.5	282.5	246.0
		I.		186.9	215.9	179.4
14*	♂	C.	34.4	43.0	43.0	38.7
		V. A	166.4	284.6	354.6	268.5
		I.		118.2	188.2	102.1
27	♀	C.	25.8	17.2	12.9	12.9
		V. A	62.3	191.7	258.6	241.1
		I.		129.4	196.3	178.8
26′	♀	C.	17.2	20.6	15.5	15.5
		V. A	82.3	247.6	301.6	240.4
		I.		165.3	219.3	158.1
32	♀	C.	30.1	25.8	21.5	21.5
		V. A	87.2	189.1	247.4	147.3
		I.		101.9	160.2	60.1
33	♀	C.	68.8	60.2	43.0	43.0
		V. A	171.9	366.9	459.6	354.6
		I.		195.0	287.7	182.7
34	♀	C.	55.9	30.1	30.1	34.4
		V. A	62.0	209.7	218.5	164.7
		I.		147.7	156.5	102.7

* Without Capsule ′ Dogs Injected with Insulin 5 I. U. Before Test.

Table 8. Serum Vitamin A and Carotene Levels in Depancreatized Dogs with Oral Administration of Aqueous Vitamin A. (7,000 I. U. per kg of Body Weight).

No. of Dogs	Sex	Operation	Days after Oper.	Time (Hours)	Before Administ.	After Admin. (3)	After Admin. (5)	After Admin. (7)
40	♀	totally Depancreatized.	29	Carotene (γ/dl.)	17.2	17.2	12.9	12 9
				Vitamin A (I.U./dl.)	43.0	108.6	74 9	66.3
				Increment (I.U./dl.)		65.6	31 9	23.3
41	♂	〃	29	C.	17.2	17.2	12.9	12.9
				V. A	37.6	99.8	83.6	63.6
				I.		62.2	46.0	26.0
41*	♂	〃	41	C.	47.3	34.3	34.3	55.9
				V. A	61.2	94.7	138.4	105.7
				I.		33.5	77.2	44.5
46	♂	〃	15	C.	17.2	17.2	13.8	13.8
				V. A	38.6	82.3	57.1	38.6
				I.		43.7	18.5	0
50*	♀	〃	14	C.	17.2	21.5	32.7	34.4
				V. A	56.1	123.1	96.8	92.9
				I.		67.0	40.7	36.8
57	♀	〃	15	C.	30.1	51.6	61.5	55.9
				V. A	69.7	89.5	121.2	67.0
				I.		19.8	51.5	27.3
59	♂	Pancreatic Duct Ligation	34	C.	27.5	31.0	27.5	27.5
				V. A	75.7	113.2	131.7	101.1
				I.		37.5	56.0	25.4

* Without Capsule

Table 9. Serum Vitamin A and Carotene Levels in Normal and Depancreatized Dogs Following Intravenous Administration of Aqueous Vitamin A. (500 I. U. per kg of Body Weight).

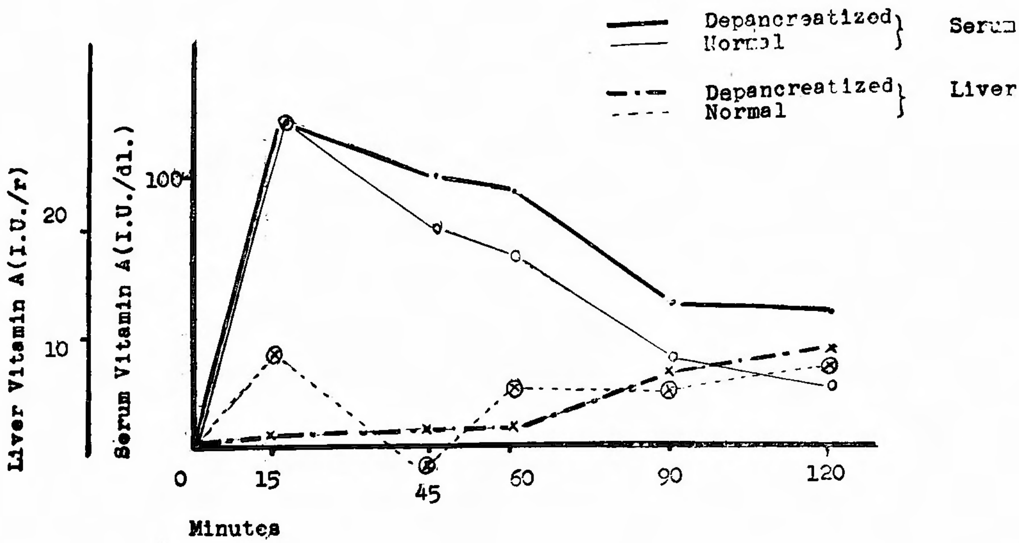
No. of Dogs	Sex	Body Weight (kg)	Operation (Days after Operat.)	Time	Before Administration	After Administration (minutes)				
						15	45	60	90	120
43	♂	14.0	Normal	Carotene (γ/dl.)	24.1	68.8	55.9	60.2	34.4	25.8
				Vitamin A (I.U./dl.)	29.9	101.9	97.0	78.3	63.2	54.7
				Increment (I.U./dl.)		72.0	67.1	48.4	33.3	24.8
				Ratio of Increment		3.4	3.3	2.6	2.1	1.9
60	♂	12.5	〃	C.	25.8	21.5	17.2	25.8	21.5	
				V. A	79.8	156.0	134.8	123.5	116.1	
				I.		76.2	55.0	43.7	36.3	
				R. I.		2.0	1.7	1.5	1.5	
61	♂	14.0	〃	C.	17.2	21.5	51.6	51.6	56.0	35.0
				V. A	117.3	221.1	177.0	168.3	149.5	147.0
				I.		103.8	59.7	51.0	32.2	29.7
				R. I.		1.9	1.5	1.4	1.3	1.3
65	♀	5.6	〃	C.	12.9	12.9	12.9	12.9		
				V. A	118.6	311.1	249.9	241.1		
				I.		192.5	131.3	122.5		
				R. I.		2.6	2.1	2.0		
66	♀	12.0	〃	C.	43.0	34.4	25.8	25.8		
				V. A	74.6	243.4	176.0	176.0		
				I.		168.8	101.4	101.4		
				R. I.		3.3	2.4	2.4		
10	♀	6.0	totally Depancreatized (64)	C.	25.8	21.5	27.5	30.1		
				V. A	108.6	387.3	359.2	400.2		
				I.		278.7	250.6	291.6		
				R. I.		3.6	3.5	3.7		
50	♀	12.0	〃 (16)	C.	20.6	8.6	30.1	17.2	13.8	8.6
				V. A	63.8	154.9	209.7	165.5	160.4	163.7
				I.		91.1	145.9	101.7	96.6	99.9
				R. I.		2.4	3.3	2.6	2.5	2.6
53	♀	12.0	〃 (8)	C.	43.0	34.4	25.8	34.4	25.8	21.5
				V. A	43.9	129.7	88.5	91.8	97.3	98.6
				I.		85.8	44.6	47.9	53.9	54.7
				R. I.		3.0	2.0	2.1	2.2	2.2
55	♂	13.0	〃 (7)	C.	25.8	25.8	21.5	17.2	17.2	21.5
				V. A	62.3	132.3	120.4	108.6	99.8	102.9
				I.		70.0	58.1	46.3	37.5	40.6
				R. I.		2.1	1.9	1.7	1.6	1.7
57	♀	7.0	〃 (21)	C.	25.8	25.8	17.2	17.2	17.2	
				V. A	36.0	180.0	110.3	91.1	99.8	
				I.		144.0	74.3	55.1	63.8	
				I. R.		5.0	3.1	2.5	2.8	
58	♂	10.5	〃 (13)	C.	17.2	25.8	25.8	21.5	21.5	21.5
				V. A	51.7	119.1	84.1	81.9	83.2	63.7
				I.		67.4	32.4	30.2	21.5	12.0
				R. I.		2.3	1.6	1.6	1.4	1.2

Table 10. The Amount of Vitamin A and Carotene in the Liver Following Intravenous Administration of Aqueous Vitamin A.

No. of Dogs	Sex	Operation and (Days after Op.)	Amount of Injected V. A (I. U.)	Liver Weight (g)	Time	Before Administration	After Administration (minutes) 15	45	60	90	120	Liver Stores of V. A in Last Test	Ratio* (%)
43	♂	Normal	7,000	410	Carotene (γ/.g)	3.44	3.44	3.44	3.44	3.44	3.44	(I. U.)	61.5
					Vitamin A (I.U/g)	27.0	42.8	30.5	30.5	34.0	37.5	4,305	
					Increment (I.U./g)		15.8	3.5	3.5	7.0	10.5		
					Ratio of Increment		1.6	1.1	1.1	1.3	1.4		
60	♂	〃	6,500	340	C.	16.5	25.8	20.6	16.5	16.5		2,380	37.3
					V. A	12.4	16.7	10.0	12.4	19.4			
					I.		4.3	−2.4	0	7.0			
					R. I.		1.3	0.8	1.0	1.6			
61	♂	〃	7,000	340	C.	3.4	3.4	4.1	3.4	3.4	5.5	1,574	22.4
					V. A	27.0	28.8	23.3	28.7	30.5	31.6		
					I.		1.8	−3.7	1.7	3.5	4.6		
					R. I.		1.1	0.9	1.1	1.1	1.1		
65	♀	〃	3,000	140	C.	7.2	8.6	12.0	5.2			2,047	68.2
					V. A	319.8	340.4	325.4	334.5				
					I.		20.6	5.6	14.7				
					R. I.		1.1	1.0	1.0				
66	♀	〃	7,000	310	C.	10.3	11.0	8.6	6.9			3,286	46.9
					V. A	200.0	220.7	190.0	210.6				
					I.		20.7	10.0	10.6				
					R. I.		1.1	0.9	1.1				
10	♀	totally Depancreatized (64)			C.	13.8	12.0	13.8	17.2				
					V. A	23.9	23.7	23.2	25.6				
					I.		−2.2	−0.7	1.7				
					R. I.		1.0	1.0	1.1				
50	♀	〃 (16)	6,000	420	C.	3.4	3.4	1.7	1.7	6.9	6.9	1,159	19.3
					V. A	49.4	49.0	46.7	45.0	50.4	52.2		
					I.		−0.4	−2.7	−4.4	1.0	2.8		
					R. I.		1.0	1.0	0.9	1.0	1.1		
53	♀	〃 (8)	6,000	410	C.	3.4	5.2	3.4	3.4	3.4	3.4	1,435	23.9
					V. A	48.0	54.5	44.2	48.7	47.9	51.5		
					I.		6.5	−3.8	0.7	−0.1	3.5		
					R. I.		1.1	0.9	1.0	1.0	1.1		
56	♂	〃 (7)	7,500	415	C.	4.1	4.1	4.1	4.1	4.1	4.1	6,848	91.3
					V. A	61.8	60.4	68.8	68.8	75.8	78.3		
					I.		−1.4	7.0	7.0	14.0	16.5		
					R. I.		1.0	1.0	1.1	1.2	1.3		
57	♀	〃 (21)	3,500	127	C.	6.9	6.9	6.9	6.9	6.9		2,222	63.5
					V. A	231.9	235.4	238.9	245.9	249.4			
					I.		3.5	7.0	14.0	17.5			
					R I.		1.0	1.0	1.1	1.1			
58	♂	〃 (13)	5,250	272	C.	4.1	4.1	5.5	5.5	5.5	6.2	3,694	70.3
					V. A	26.8	21.5	28.1	21.1	23.4	40.1		
					I.		−5.3	1.3	−5.7	6.6	13.3		
					R. I.		0.8	1.1	0.8	1.2	1.5		

$$^{*}\text{Ratio} = \frac{\text{Amount of Vitamin A of the Liver}}{\text{Amount of Injected V. A}}$$

Fig. 6. Curves Showing Increments of Averaged Amounts of Serum Vitamin A and Curves Showing Increments of Averaged Amounts of Vitmain A Contained in the Liver Respectively after Intravenous Injection of Aqueous Vitamin A. (in Depancreatized Dogs and Normal Ones).



Occlusion of the Cerotid Arteries

Miller Fisher, M.D.

A.M.A. Arch. Neurol. and Psychiat., **72**, 187, 1954.

最近2年間に著者は日常行われている死体解剖に於て一側性或は両側性頸動脈閉塞を45例に発見した．之等の症例は Montreal General Hospital (Canada) と St. Anne's Hospital から得たものであるが前者に於ける一般死体解剖432例の中28人 (6.5%) が一側或は両側頸動脈の完全閉塞を有し，之は脳出血例の数と略々等しく脳栓塞の症例の約半分であつて頸動脈閉塞は今迄信じられていたよりも遥かに多いものであることが判つた．

頸動脈閉塞の病理像は複雑であるがその基礎となるものはアテローム性動脈硬化症であつて頸動脈洞に好発する．半身不随を伴つた症例で閉塞された頸動脈洞の末梢の内頸動脈内に続発性血栓を発見するのは普通のことである．この血栓は時と共に器質化して間もなく動脈は細くて固い索條となつて了う．斯様に頸動脈洞内に高度なアテローム性動脈硬化があり，その末梢に血液凝固物或は索條が見られることは，原発性の閉塞は頸動脈洞に在り内頸動脈の末梢部に於ける変化は続発性のものであることを示すものである．

頸動脈閉塞を有する患者は通常55才以上の老人であつて原則として四肢とか心臓にアテローム性動脈硬化の他の徴候が存在する．

臨床像には色々の変異があり全く症状を伴わないものもあるが最も特徴的なものは一側性閉塞に於て見られる半身不随であつてその前駆症状としては，一過性の知覚異常，不全麻痺，失明，言語障害，頭痛，眩暈，ホルネルの症候群，失神等が挙げられる．両側性閉塞に於ては初め一側のみの閉塞によつて無症状の儘経過し，或は半身不随となり，他側が閉塞された時に初めて両側性の神経徴候や昏睡が明らかとなる．又一側性或は両側性閉塞の症例のある者には老人性痴呆が合併した．頸動脈閉塞の臨床的並びに病理学的研究は脳血管疾患の中で従来謎とされていた症例の多くのものに対して解決を与えるであろう．　(大谷圭三抄訳)